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TWO REVERSED PARTIALLY AMBICOLORATE HALIBUTS: *HIPPOGLOSSUS HIPPOGLOSSUS*

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INTRODUCTION

In 1935, we published an article on an almost totally ambicolorate halibut with a partially rotated eye and a hooked dorsal fin. This fish (the most abnormal halibut ever described up to that time) was normal in only one thing—it was right-handed or right-pointing or dextral. The two halibuts now under consideration show much less coloration on the under side than does the 1935 specimen, and have no head anomalies. However, they are not merely partially ambicolorate but have the added anomaly of being reversed or left-handed. Firth obtained these from fishing vessels discharging at the Boston Fish Pier. The history of each will be given later.

THE NORMAL FISH

In order that the marked abnormalities of our fish may be more readily perceived and understood, we insert here a figure showing the right or upper side of a normal halibut. In this figure, attention is called to three particular structures in the make-up of this, the largest member of the flatfish group: (1) Along the dorsal and ventral edges of the dextral or upper side are certain small whitish blotches. Whatever the cause, these are not abnormalities, since they are generally present and are more readily seen on the larger halibuts. (2) Note the large jaws filled with large strong recurved teeth. These indicate that our fish is an active predator. (3) Particular attention is called to the very high position of the upper, the rotated or left eye. While clear of the dorsal crest, it is very close to this. Furthermore, the anterior termination of the dorsal fin reaches to and often beyond the middle point of this migrated eye. See Fig. 1. The whole lower surface of this normal fish is of course dead white in color.

It should be stated here that at Boston and Gloucester two grades of halibut are distinguished: First, those fish having pure white under sides,

which bring the highest price; and second, those having the under side of a more or less uniform grayish cast. These bring a lower price. These are called "gray halibut" and are generally the larger fishes. However, the grays are halibut and are recognized by the fishermen as different from the others only in this matter of the faint lower-side coloration. This grayish color, has, moreover, nothing to do with ambicoloration.

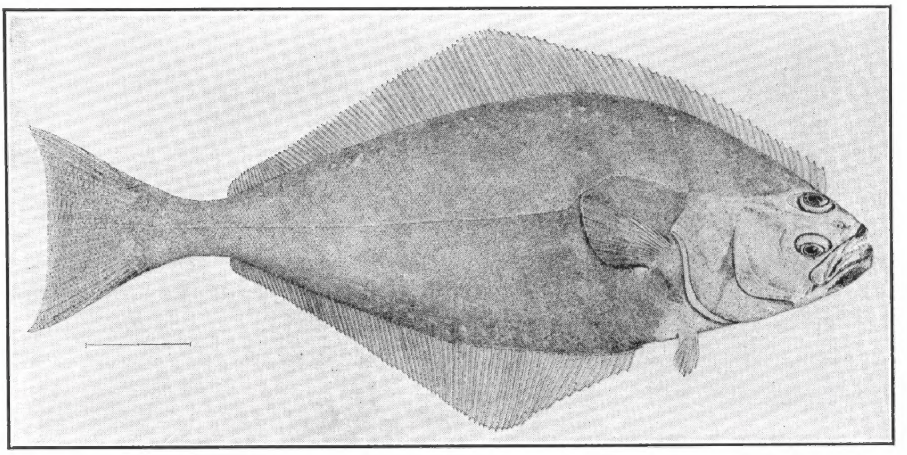

Fig. 1. Upper surface of a normal halibut, *Hippoglossus hippoglossus*. Note that the rotated eye is placed high on the side of the head, near the dorsal crest but free of it, and that the dorsal fin ends in line with the middle of the rotated eye.

The spots on the dorsal and ventral edges of the body are not abnormalities, as the text explains.

After G. Browne Goode, 1884.

THE ABNORMAL FISH

Each of our specimens presents a double anomaly—each is reversed, i.e. is sinistral or left-pointing; and at the same time is partially ambicolorate, i.e. has the normally-white lower side more or less colored.

THE REVERSED HALIBUTS

A halibut is an abnormal fish in that, instead of swimming with its dorso-ventral axis standing vertically, it lies and swims on one side with this axis in a horizontal plane. Moreover each genus of flatfishes has a definite side on which normally to lie. Thus the halibut lies on its left side, which is blind and white, while its right or upper side is colored and eyed (Fig. 1). It is then dextral or right-pointing.

To become reversed, it must be turned from right to left on its tail as an axis so that the left side is now above, eyed and colored, while the former eyed and colored right side now becomes the lower, blind or white side. This is what has happened to both our fish. Both have become sinistral, left-pointing.

Since no reversed halibut has ever been figured and described, we call attention in Fig. 2 to the smaller of our left-handed fish. It is uniformly dark-colored throughout save for certain white areas in the tail-fin and certain white irregular-shaped blotches just under the bases

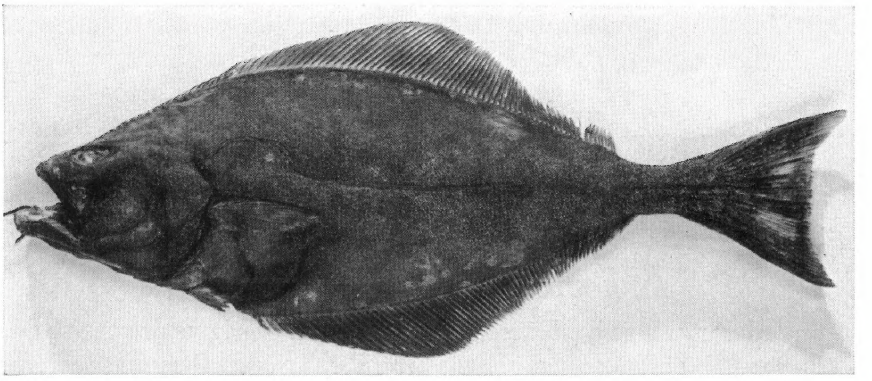

Fig. 2. A reversed halibut (*Hippoglossus hippoglossus*), the first ever figured. This fish is normally right-pointing. At bases of dorsal and anal fins are white blotches which have come over with the color. Compare this fish with the normal one in Fig. 1.

Photograph by A. M. N. H.

of dorsal and anal fins. These latter correspond to what are shown in Fig. 1 and described in the section on the normal fish. They are normal features which have come over on the left side in the reversal of surfaces. On the tail are white areas, which (as will be seen later) correspond to what are found on the under side.

Reversed specimens of *Hippoglossus* are exceedingly rare. In a prolonged search of the literature, Gudger (1935, p. 14) could find but 3 brief records—not descriptions. Storer (1839, p. 146) remarks that reversed specimens of the great halibut are occasionally met with and that in 1838 he had seen in the Boston market, such a fish weighing 103 lbs., "with the left side colored, [and] bearing the eyes." In the section on the halibut in his book, Goode (1884, p. 197) states that left-handed specimens are sometimes taken—"about one in five thousand...

having the eyes on the left rather than upon the right side of the head." And Parker (1903, p. 232) found but one sinistral individual among all the halibuts handled in Boston in the winter of 1900–1901 by the largest halibut establishment there. "It was certainly a single individual in many thousands."

Of the closely related form, *Reinhardtius hippoglossoides*, Norman in his great book on the "Flatfishes" (1934, p. 290) records that he saw a reversed specimen in the "Dana" collection from off northern Iceland. Lastly, Jordan and Evermann say that in *Hippoglossoides elassodon* occasional sinistral specimens are found; but Norman found none in the U. S. National Museum material examined by him.

All this is to say that reversal in halibuts is an almost unknown phenomenon. Hence our specimens from this point of view only are exceedingly interesting. Since no figure of a reversed halibut has ever been published, we reproduce here from a photograph the upper surface of our smaller fish as Fig. 2. But the anomalies of our specimens do not stop with simple reversal—as we shall now show.

AMBICOLORATE REVERSED HALIBUTS

In ordinary reversed flatfishes, the reversed sides have reversed colors —the normally blind and colorless lower side, becomes the upper, colored, and eyed side; and the normally eyed, colored, upper side, becomes the lower white blind side. Our specimens are blind below but are partially ambicolorate, i.e., partially colored like the upper side. This we will now show for each fish separately.

The Smaller Fish.—This interesting specimen was taken on June 24, 1935, by the boat "Gertrude De Costa," Capt. Albert Hines master, fishing in 75 fathoms in one locality from 5 to 15 mi. N. W. of Brown's Bank, which is about 50 miles S. S. W. of Cape Sable, Nova Scotia. It was taken in a line-trawl catch of about 5000 lbs. of halibut of similar size, and so far as Firth could learn was the only fish of the kind in the lot. When received by Firth at the Boston Fish Pier on June 27, it measured over all 17.9 in., was 6 in. wide (body only) and weighed 27 oz. The great halibut (*Hippoglossus hippoglossus*) grows literally to a great size. Goode (1884, pp. 193–194) quotes Captain Atwood (everywhere in his day accredited as an exceedingly accurate observer) that in 1879 he saw specimens which weighed 359 lbs. (302 dressed) and 401 (322 lbs. dressed). Goode says such fish would have measured between 7 and 8 ft. long and 4 ft. wide. Hence it is seen that our fish is a mere baby, but a most interesting specimen nevertheless.

Our fish is reversed, and as such it has been described. Hence nothing more need be said save to note the inequality in size of the pectoral fins. The fin on the blind side (under—right) measures 43 mm. while the one on the eyed (upper—left) side is 60 mm. long, or nearly 40% longer. This inequality has been noted in the pectorals of other flatfishes. The flatfishes are bottom dwellers and (mostly) bottom swimmers. As such, it is pretty clear that in our fish the left pectoral would be more used than the right, and hence would be better developed. This inequality in size of the pectorals may be demonstrated

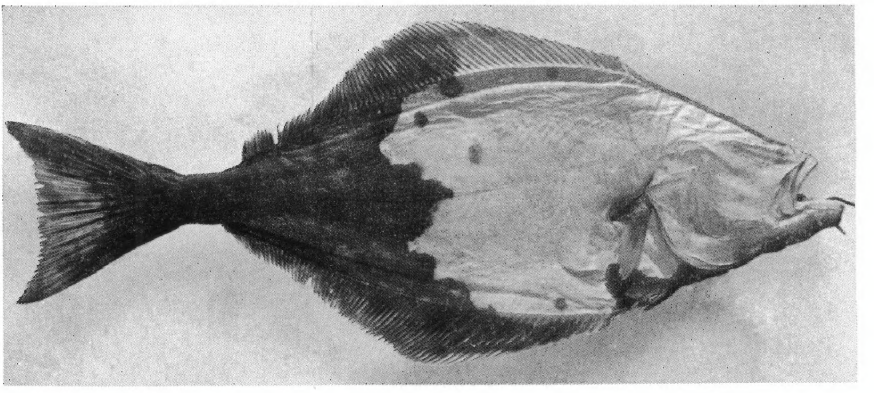

Fig. 3. Lower (right) side of halibut, *Hippoglossus hippoglossus*, seen in Fig. 2. This reversed side should be white but is partially ambicolorate.
Photograph by A. M. N. H.

by measuring the left pectoral in Fig. 2 and the right one in Fig. 3 (made on the same scale). The lower side of this specimen is ambicolorate as Fig. 3 shows. Almost the hinder half of the tail-fin is white, but all told approximately one-third of the under area is colored almost exactly as is the upper side. As Fig. 3 shows, the line separating the light and dark areas is a very irregular one. Along the lateral line the color extends forward in a peninsula bounded above and below by white bays. On either side of these but especially on the ventral edge, the dark areas extend forward on body and on the unpaired fins. The anal fin shows more dark, and this color extends forward to the anal region and connects up with a dark area coming over from above and covering the lower forward fourth of the visceral region. Noticeable are the dark islands scattered (four above and one below the lateral line) about in the white area. Since there are no spots on the upper surface, there is

no correlation here as in the case of the four-spotted flounders (*Paralichthys oblongus*) described by Gudger and Firth in 1936. The front base and nearly the forward half of the pectoral are dark. It is interesting to note the white color of the spread out fin-rays of the caudal. This was observed by Firth on the fresh fish and we judge it to be the original white color of the under side and not an artifact due to scraping off of the epidermis.

Specimen No. II.—Our larger fish was taken on May 20, 1935, by the schooner "Adventure," Captain Leo Hines master, while fishing for cod and haddock about 60 mi. E. by S. of Sable Island in 75 to 80

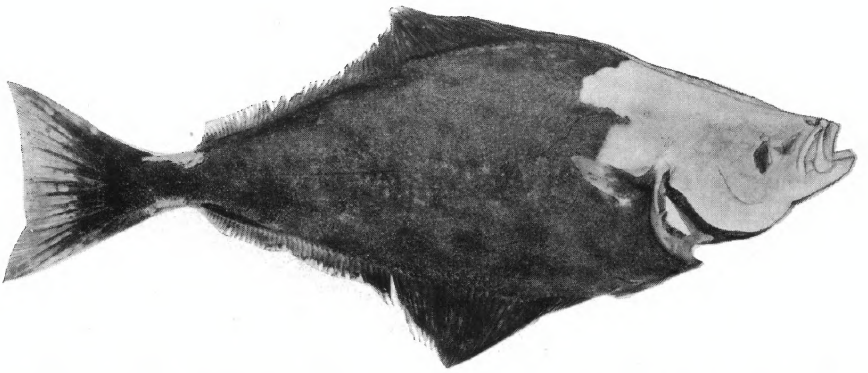

Fig. 4. The ambicolorate lower side of our larger (30-inch) reversed halibut (*Hippoglossus hippoglossus*). This fish and that shown in Fig. 3 are the only ones of their kind ever figured.

Photograph by A. M. N. H.

fathoms. Our fish was actually caught by Larry Nolan and Lawrence Goodwin, dorymates, who found it on one of their trawl hooks. Not being interested in "chicken halibut" (the name given these small fish by the trade) they were of half a mind to throw it back, but noticing that it was a freak fish they fortunately kept it. When Firth saw it at the Boston Fish Pier, he at once seized it in the interest of science.

When the fish came off the boat, Firth took its measurements as follows: length, 30 in.; width (body only), 9 in.; weight, 9.5 lbs. He was greatly pressed with other work, so he had the fish put in the freezer and later sent it frozen to New York by express. Gudger (also crowded with work) did not properly defrost the specimen and because of its large size put it in a tank of strong salt solution instead of alcohol. As a result of these two errors, the epidermis began to slip and the fish

showed signs of breaking up. It was at once put in alcohol, and as soon as it had hardened somewhat it was photographed.

The upper side has been badly mauled, but is dark throughout like the upper side of a normal fish save that the hinder part of the tail-fin is light—very like what is seen in the upper side tail of our smaller specimen (Fig. 3). Such is Firth's description of the fresh fish. There are no eye nor dorsal fin anomalies. The upper side of our smaller fish being entirely normal (Fig. 3), there is no need to figure the mauled and defective upper side of the larger specimen.

Our interest centers in the under side—excellently shown in Fig. 4. Here the slipped epidermis (very slight in amount compared with that on the upper surface) has been restored in accordance with Firth's description of the fish when fresh and with what Gudger found when he unpacked the fish. The retouching was done under Gudger's eye by a skilled artist, accustomed to work on fishes. Fig. 4 shows the fish as it was when it came off the boat. The three dark areas on the front head region are abrasions in the white skin made in handling the fish on the boat.

The anal fin is dark throughout, the hinder half of the caudal and the pectoral fin each is white, that of the pectoral a dead white like the region above the shoulder and over the head. The throat region and the under and hinder parts of the branchiostegal region are dark. It should be noted that the under side of the dorsal fin is dark up to the beginning of the white shoulder region and that adjacent to the white shoulder and head region it is intermediate in hue between the dark of the body generally and the light of the anterior white parts. Since the dark area does not encroach on the head region, there are no eye nor dorsal fin anomalies. This is in conformity with the general rule, to which thus far but two or three exceptions have been found.

These are the only reversed ambicolorate halibuts on record, hence they are unique—there are no others known. However, there are on record two other reversed ambicolorate flatfishes. Gudger has recently described (1936) a reversed almost wholly ambicolorate summer flounder *Paralichthys dentatus*. This fish (15 inches long) had the whole lower body and about half the head as dark as the upper side. Hence, in accord with the general rule it had an almost cyclopean eye and a hooked dorsal fin. Furthermore, Cunningham (1907) has figured and described a reversed small turbot (44 mm., 1.7 in. long) partly ambicolorate on the blind side and white on the eyed side. It, however, was hardly more than a post-larval young.

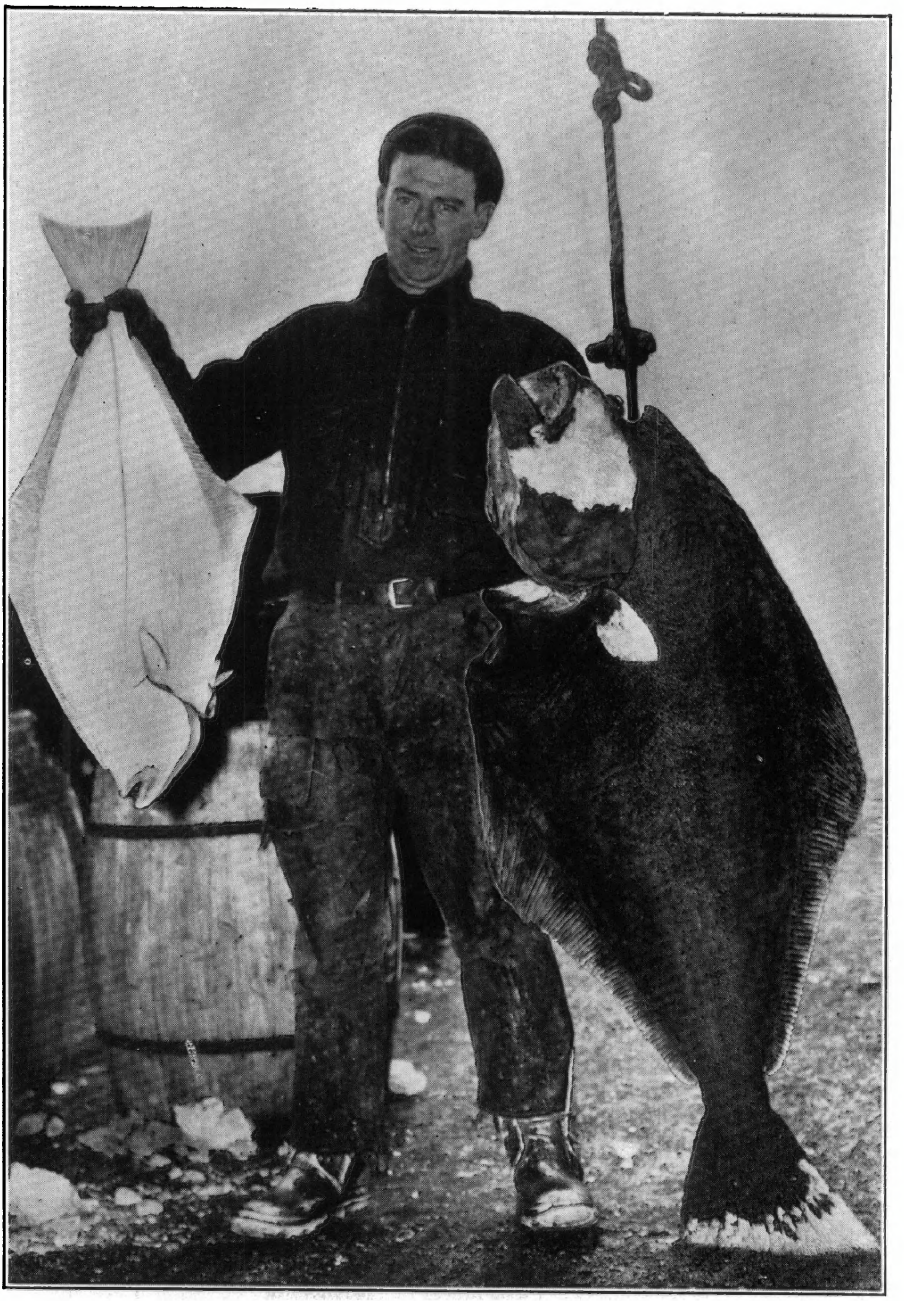

Fig. 5. Ventral surfaces of two halibuts (*Hippoglossus hippoglossus*). The smaller fish has the normal white under surface. The larger or abnormal fish is nearly completely dark below, has an incompletely rotated eye and a hooked dorsal fin—both of which are absent in the normal fish.

From a photograph in A. M. N. H.

Statement has been made of the fact that in cases of extreme ambicoloration—when as much as one third of the head and cheek region is colored, then one may expect to find an incompletely rotated eye and a hooked dorsal fin. Since we have figured such an anomaly in a large dextral *H. hippoglossus* secured by Firth in Boston early in 1935, and since the cut is at hand for giving an illustration, we reproduce this fish as Fig. 5. This shows the three common anomalies well and calls for but one other remark. It should be noted that the large ambicolorate fish of Fig. 5 like our two specimens shown in Figs. 3 and 4 has not only a partially white head, but also has the hinder halves of both pectoral and caudal uncolored.

No explanation is at hand for any or all of these anomalies. This must be found in genetics, a subject in which neither of us is versed enough to warrant an excursion. Later, the senior author plans to bring together in general articles all the records of ambicoloration wherever published in the hope that therein some understanding may be found of this and the accompanying anomalies.

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